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NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS.

Technical Memorandum No. 59.

T H E G L I D E R

Of the College Aviation Group of the Technical High School, Hanover.

By

W. Blume.

FOR PREFERENCE

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Taken from
"Zeitschrift für Flugtechnik und Motorluftschiffahrt,"
November 15, 1931.

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To be returned to
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THE GLIDER

Of

The College Aviation Group of the Technical High School, Hanover.*

By

W. Blume.

The Glider of the College Aviation Group was constructed from a design of Dr. Ing. G. Madelung, and under his direction by the Students of the Hanover Technical High School, Messrs. W. Blume, Hentsen, Martens, as students' work. They were encouraged in this work and helped technically by Prof. Dr. Ing. A. Pröll and Dipl. Ing. H. Dornier, Chief Engineer of the "Hawa" Concern. The aerodynamical characteristics and stability were tested in the Göttingen Aerodynamical Laboratory (See Figs. 3 and 4). The glider was equipped with pneumatic tires and skids by the Continental Rubber and Guttapercha Company.

The design and construction were based on the following principles:

1. From an aerodynamical point of view, the glider will be made to descend as slowly as possible. A gliding angle and a value $\frac{C_a}{C_w}^3 = 300$ may be reached by the choice of a very good aspect ratio, a profile of specially good penetration, avoidance of dead resistances, and a very good form of fuselage.
2. For static requirements, rigidity and resistance are arranged to meet the conditions of very varied loads.
3. The construction is as simple as possible.

* From "Zeitschrift für Flugtechnik und Motorluftschiffahrt," November 15, 1921.

4. From the practical point of view, great ease of assembling and demounting has been sought.

The shape and dimensions are given in Fig. 1.

The wings are of the cantilever type and have a span of 13.6 m. The chord of the wing in the center is 1.45; at the extremities, 0.75 m. The wing area is 16 square meters and the mean aspect ratio 1:10. For the practical reasons above mentioned, the wings are made in three parts. The middle part is made with a constant profile so that it forms an angle of zero incidence with the upper surface of the fuselage. The center wing is 35 cm. thick. In the outer parts the angle of incidence becomes smaller while at the same time the wings are reduced in thickness.

The construction of the wing differs from the usual two-spar type. The main spar is an I-beam lying in the mean line of pressure and specially strengthened by means of girders and a lattice work web. The dimensions of this beam have been arranged with a view to preventing damage to the glider in case it should turn over on the wing tips in landing. The spar offers great security since the factor of safety is everywhere over five, and in parts, exceeds ten. By giving a suitable form to the flanges the weight is reduced to a minimum. The part of the wing in front of the spar is covered with plywood and, with the spar forms a rigid torsion tube. This tube has everywhere a factor of safety of at least 3.5 and also increases the factor of safety of the I-beam. By this arrangement an extremely rigid and strong wing is secured as well as a very smooth and firm

leading edge, thereby ensuring a good preservation of the profile.

The main ribs are at a distance of 0.5 m. from each other. They are standard ribs, each being able to support a weight of about 40 kg. By using suitable materials great economy can be made in weight. In the spaces between the main ribs are placed secondary ribs in the forward part and on the upper side of the rear part in order to strengthen the wing. The rear part is covered with a light, strong fabric.

The wing is attached to the fuselage in three places. The main attachment is a bolt joining the wing I-beam with the fuselage. The wing is also attached to the ends of two struts which are connected with two vertical fuselage struts. The bolts are easily accessible, ensuring rapid demounting.

The wing parts are intentionally over-dimensioned and are also so formed that when the bolts are loosened the wing can be moved backward or forward by 20 cm. When the bolts are tightened the wing is again solid. It can therefore be exactly balanced. For instance, it can fly close behind another airplane of very different weight without causing any change of position, though with another type of airplane such change could only be avoided by means of additional weight or an inefficient angle.

The form of the attachments further gives free action to the wing and eliminates all danger of the loosening of the bolts. Still, as further security in case a severe shock on the wing tips caused by a sideslip in landing should throw extra stress on the smaller and weaker connections, the wing is supported by

a short, strong strut connecting the wing spar with the fuselage.

In designing the connections of the outer parts of the wing with the middle part, especial care was taken to make a connection which would be proof against landing shocks and sudden dives during flight. This is done by running special end spars from the torsion tube to three points, namely, to the two flanges of the I-beam and to the nose.

The flanges and web of the I-beam are assembled by a fitting, throwing the bending and tension stresses on the flange bolts. A second device with a bolt on the nose of the spar bears the stress arising from head resistance and, in connection with the main spar fitting, that arising from torsion. All three bolts can easily be loosened and are quite accessible, so that the end parts can be taken off in a few minutes. This gives great facility for carrying out repairs.

The ailerons are flaps, each having an area of 0.82 square meters. They are actuated by control wires.

The fuselage was also designed in accordance with the principles already given, especial value being attached to stability, simplicity of construction, and good view for the pilot. The form of the nose of the fuselage and the arrangement of the cockpit and fuselage under the wings are based on aerodynamical grounds and on the necessity of giving the pilot the best possible view. The tail was fixed as high as possible in order to give a large angle of incidence at starting and landing.

So that the pilot may be assured of ample protection when in difficulties, the fore part of the fuselage has been made extra rigid. The strengthening device consists principally of two strong ash hoops, stretching from the nose round the thickest part of the fuselage and including the pilot's seat. These hoops are connected with two cross bars to the forward part of the frame. The fuselage is entirely covered with plywood.

The tail is quadrangular and is constructed on the usual framework principle. The ends are covered with plywood and the upper and lower surfaces with fabric. In this way we get an extremely rigid and resistant structure which is very light, weighing about 25 kg.

The balanced elevator forms the horizontal portion of the tail. It has an area of 1.875 square meters and is actuated through a bar. The axis of rotation is chosen so that it lies in the center of pressure and the bar does not require much power. The unbalanced rudder lies above the fuselage. It has an area of 0.42 square meters and the fin an area of 0.9 square meters. The rudder is actuated through control wires, which, like the bar, are inside the fuselage. Both elevator and rudder can easily be demounted. The arrangement of controls in the cockpit is the one usually adopted up to the present and consists of lever and foot controls.

The usual method of launching was not adopted since it involves great resistance at the start and is very disadvantageous in the case of a glider. These considerations led to the choice of a landing gear in which the wheels are replaced by balls.

The axles of these balls are in the fuselage and are easily accessible. Both the axles and balls can easily be replaced. Under the fuselage only the bottom of the balls is visible. They cause scarcely any head resistance and facilitate the take-off. Furthermore, on account of the landing gear design the machine can easily glide laterally in case a side wind should be blowing, and that without giving rise to any dangerous stresses.

The problem of the landing gear has been solved in a particularly ingenious way so as to form a pneumatic spring suspension. One of the three balls is placed at the nose as an impact wheel; the other two lie almost under the center of gravity of the glider.

In designing the landing gear, one of the requirements was to provide pneumatic supports which, in case of a crash, preserve the wing tips from injury.

The performance expected from the construction of the glider were fully realized in the Rhône Gliding Competitions of 1931.

Translated by Paris Office, N.A.C.A.

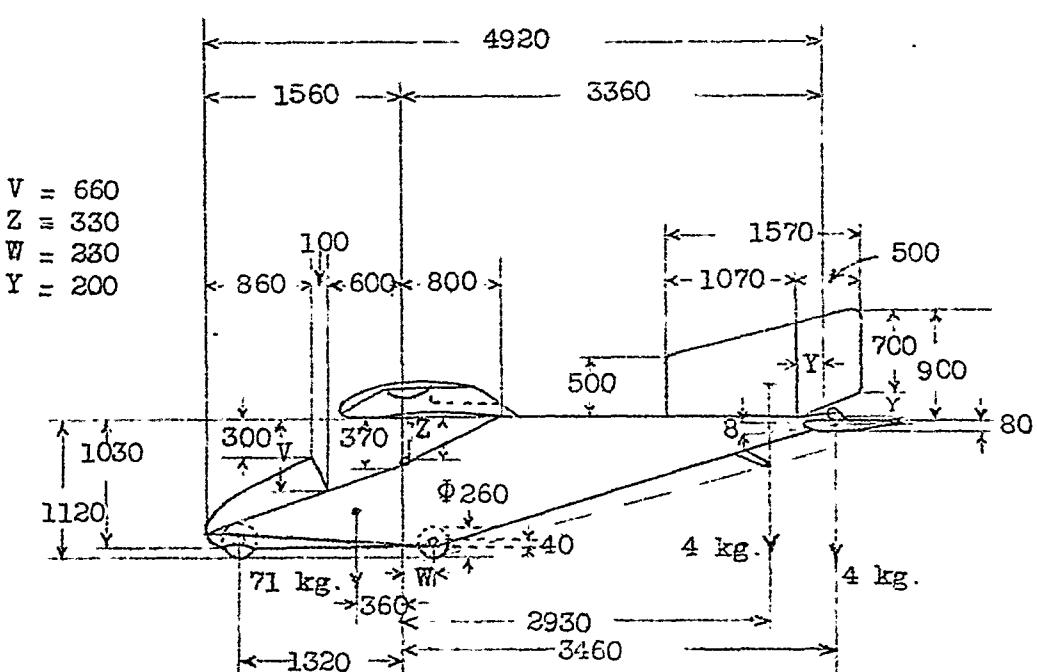
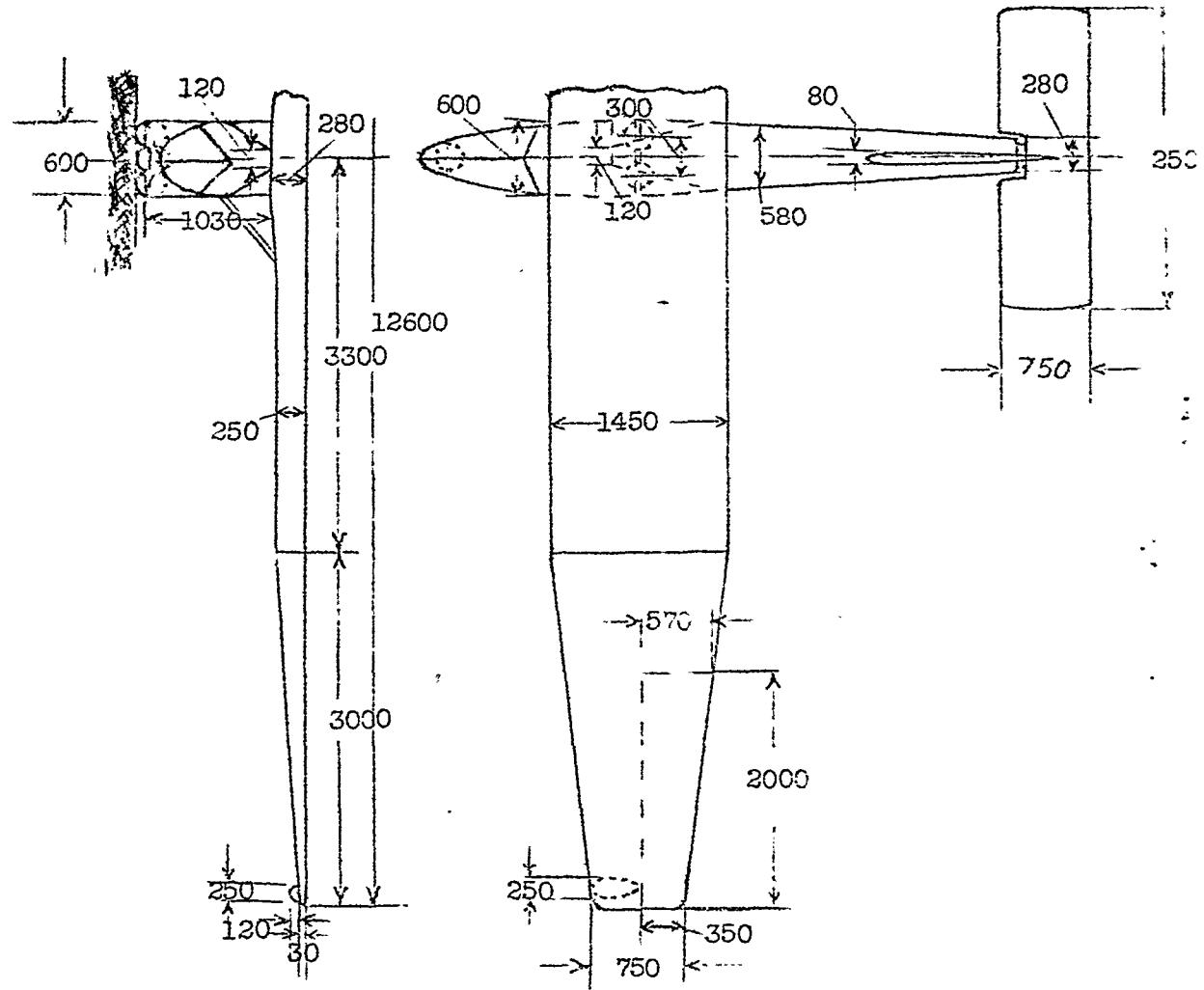


Fig. 1 - Glider of the Aviation Club of the Hanover Technical High School.

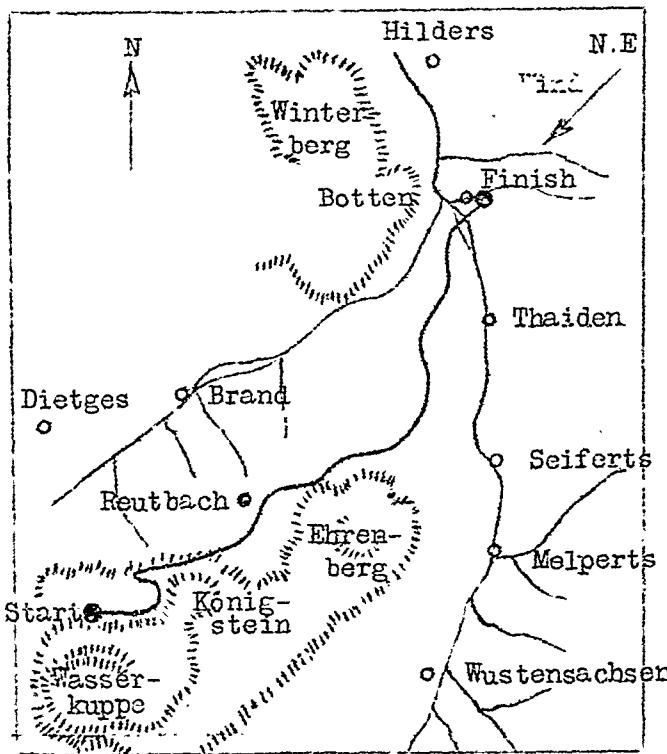


Fig. 2 - Performance of monoplane glider of
the Hanover Technical High School, 9/5/21.

Pilot	Time	Distance	Height of
Martens	15' 40"	7500 m.	starting point 400 m.

Aerofoil section at center

Fig. 3.

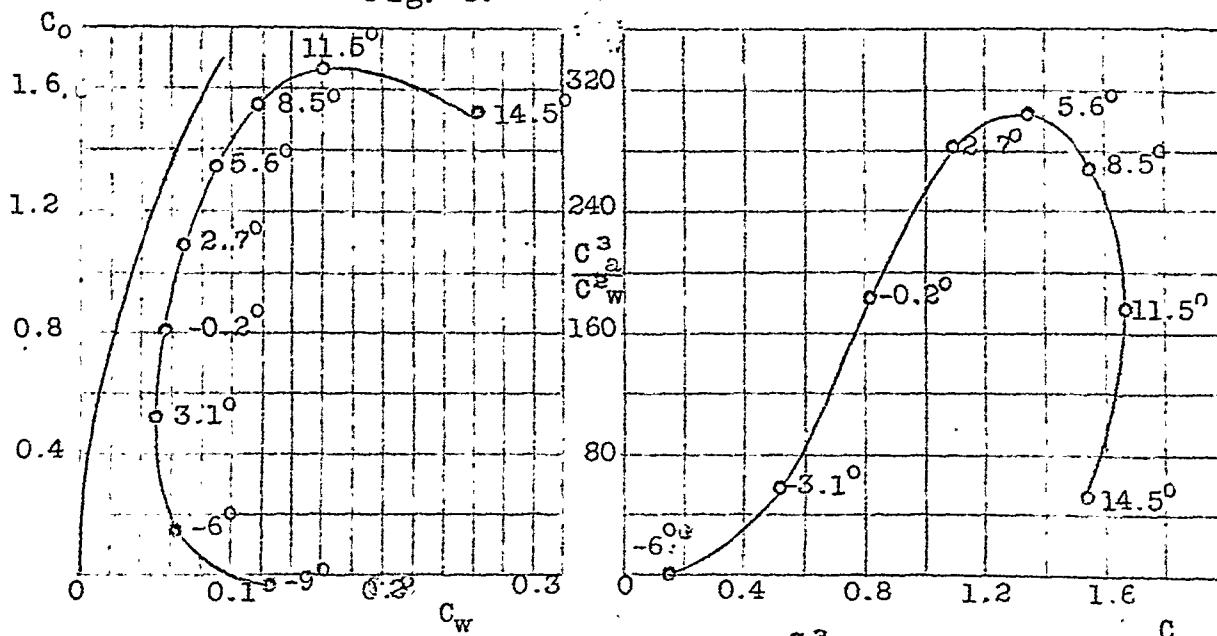


Fig. 4. Polar diagram and curve. $\frac{C^3_a}{C^2_w}$

of the model of the gliding airplane.

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